THE WEATHER AND CIRCULATION OF SEPTEMBER 1967

A Month of Continued Record Warmth in the West, Coolness in the East, and Frequent Tropical Activity

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1. HIGHLIGHTS

In most areas of the Nation, the temperature patterns of July and August persisted into September 1967, resulting in cool spells, heat waves, and dry periods of record-breaking length. Some sections of the South have had record-breaking coolness all summer, while excessive heat and continued drought plagued much of the Northwest. Maximum temperatures averaged in the eighties during September 1967 for only the second time since 1892 at Missoula, Mont. Temperatures soared into the nineties numerous times throughout the month in the Far West and Northern Rockies, setting new records for the total number of days with 90° F. or above for the month or for the season. Several stations reported the end of record-breaking dry spells during September, as many as 81 consecutive days without measurable rain at Pendleton, Oreg. Only 0.01 in. rain was measured from June 23 to Sept. 29 at Yakima, Wash., and 0.07 in. during the past 3 months at Red Bluff, Calif.

Tropical storm activity was high in both the Atlantic and Pacific during September 1967, with five and 11 storms, respectively. Two of the storms brought unusually heavy rains to parts of the United States; in particular, Hurricane Beulah flooded the entire lower Rio Grande Basin and adjacent watersheds with rains in excess of 20 in. At the beginning of the month, Tropical storm Katrina brought a season's normal rainfall to parts of the Southwest. In the Atlantic, after following an extremely erratic path, Hurricane Doria was the first tropical cyclone of record to strike the mid-Atlantic coast while moving in from the northeast. A detailed description of the tropical activity will be given with the discussion of weekly circulation and weather later in this article.

2. MEAN CIRCULATION

The Northern Hemisphere 700-mb. circulation was dominated by the deepest September mean Low of record ever observed in the Gulf of Alaska (fig. 1). Peak monthly mean wind speeds south of the vortex reached 26 meters per second, which is 16 m.p.s. above normal. The height anomaly of 610 ft. below normal (fig. 2) was over 200 ft. lower than any previous September anomaly to occur in that region for more than 30 yr. of Weather Bureau records. This intense Gulf of Alaska Low represented a monthly 700-mb. height fall of 340 ft. more than the normal August to September change (fig. 3). Another deep vortex which was 380 ft. below normal was located over northern Baffin Island. These centers of action gave rise to a generally high index situation, although weak positive anomalies were observed north of the Bering Straits and over Scandanavia (fig. 2).

Southern Canada and the northern United States were dominated by a large zonally oriented band of above normal heights extending from the Pacific Coast to the central Atlantic. This pattern was somewhat unusual, as ordinarily a deep trough would be expected downstream from the strong Pacific trough. The positive anomaly center of 130 ft. in Western Canada constituted a persistence of the July and August patterns, but the above normal heights south of Hudson Bay represented a reversal ([1] and [2]). Heights were below normal at low latitudes over the United States and the Atlantic, resulting in unusually weak westerlies and easterly anomalous flow over most of the Nation (figs. 1 and 2).

Heights increased to above normal values at lower middle latitudes of the east and central Pacific (figs. 2 and 3). A large area of below normal heights in the southwest Pacific reflected frequent tropical cyclone activity. One of the storms was so large and slowly moving that it contributed to an actual Low center in the monthly mean circulation (fig. 1). The below normal 700-mb. heights over the southern Atlantic and United States were also in part due to tropical activity. The monthly mean height anomaly pattern for September 1967 (fig. 2) bears fairly good resemblance to those shown in the composite charts for months of maximum tropical cyclone activity in the North Atlantic [3]. This past September, however, the band of positive anomaly was farther north in the western Atlantic and North American sectors.

Sea surface temperatures were above normal throughout much of the mid-latitudes of both the Atlantic and Pacific (fig. 4), a factor which is believed to enable tropical cyclones to maintain their strength longer and into higher latitudes. The large areas of warm surface waters were built up during the summer when ridges were stronger than normal over the central oceans (see figs. 1

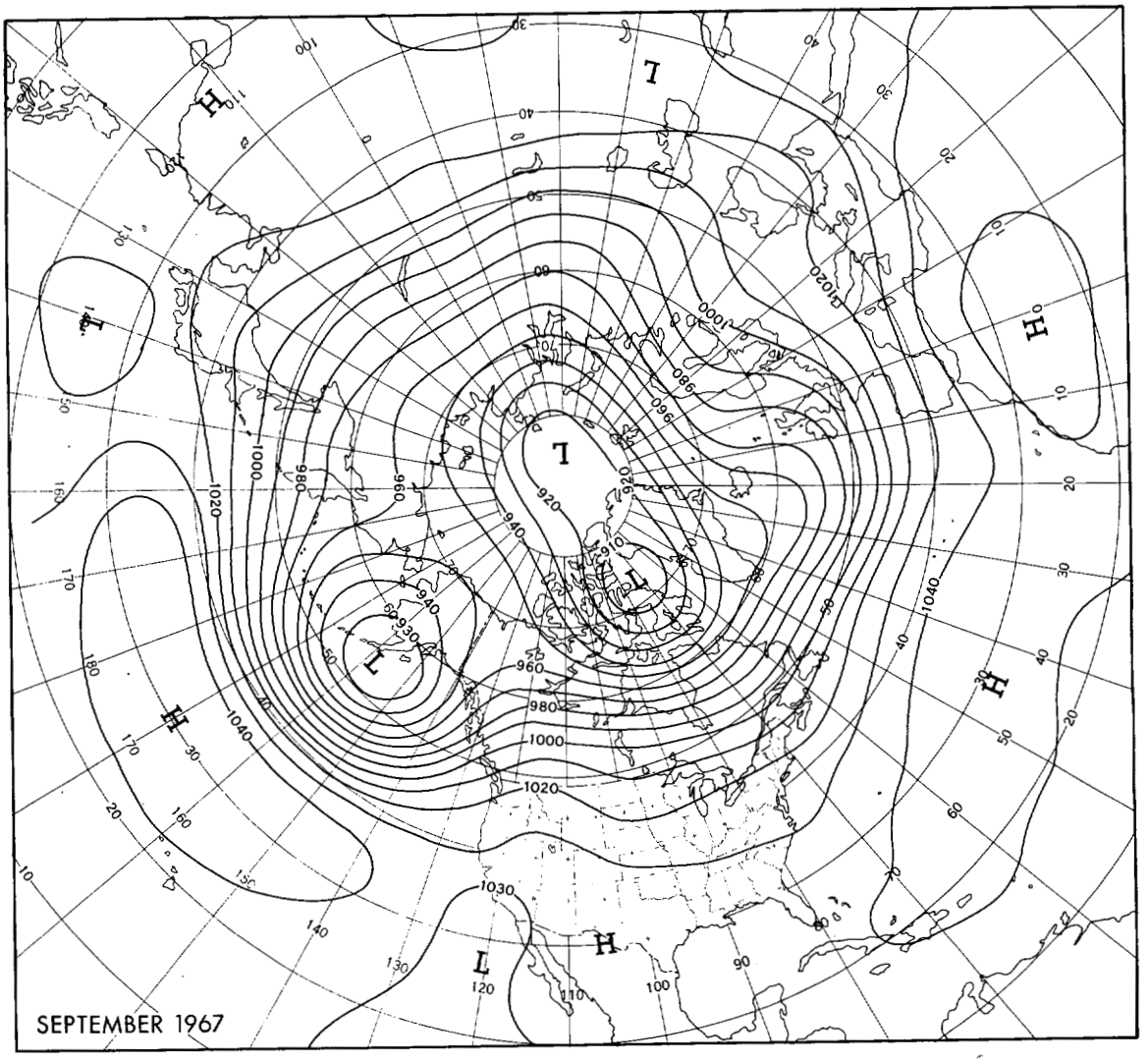


FIGURE 1.—Mean 700-mb. contours (tens of feet) for September 1967.

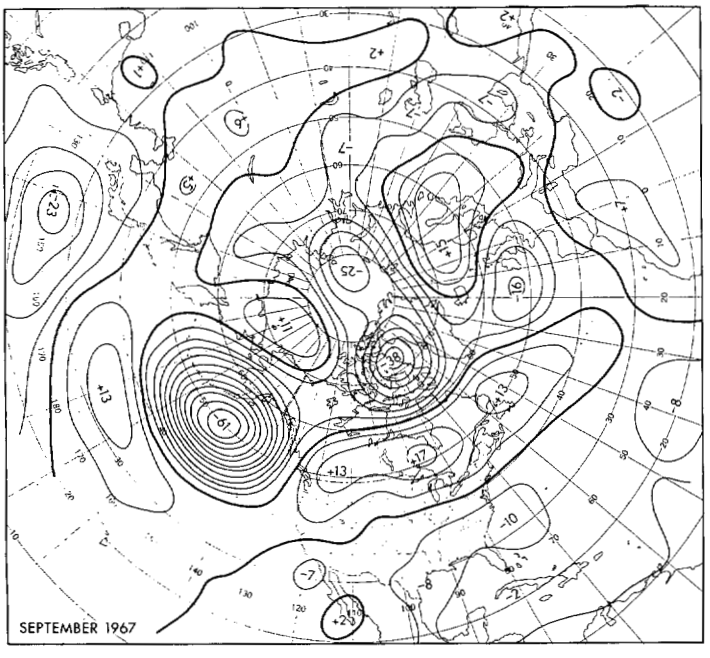


FIGURE 2.—Departure of mean 700-mb. height from normal (tens of feet) for September 1967.

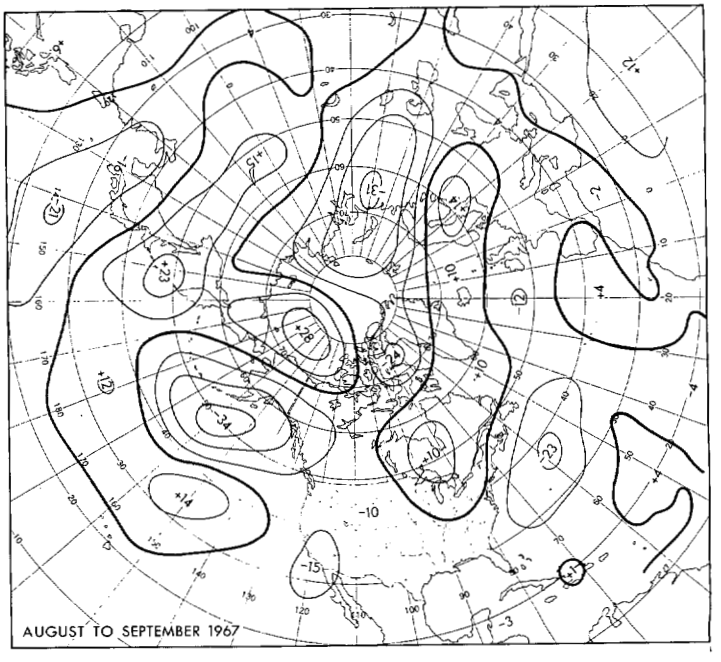


FIGURE 3.—Change of departure from normal of mean 700-mb. heights (tens of feet) from August to September 1967.

and 2 in [1] and [2]). 700-mb. heights had already fallen to below normal values near the Aleutians in August, and the increasing vigor of the circulation in September acting on several frontal waves, some containing the remnants of typhoons, produced several intense storms in the Aleutians and Gulf of Alaska. The relative locations of the warm surface water and area of rapid cyclogenesis are similar to those in a case discussed by Namias [4], although farther west.

It is interesting to note the close correspondence between the negative circulation anomalies in figure 2 and the negative sea surface temperature anomalies in figure 4 west of the British Isles, in the southern Gulf of Alaska, and over the southwestern Pacific. Abnormally strong cyclonic circulation at sea level (similar to fig. 2 but not shown) led to surface divergence and upwelling of cooler water in the oceans.

3. TEMPERATURE

Abnormally cool conditions continued over the Southeast during September 1967, with some areas averaging more than 8° F. below normal for the month (fig. 5). At the same time, persistent heat prevailed over the Far West, the Northern and Central Rockies and Northern Plains, with greatest departures of over 6° F. above normal centered in Montana. The monthly temperature and height anomaly maps correspond quite well, as seen by comparing figures 2 and 5.

Coolness in the Midwest and Southeast was due primarily to several cool surface Highs which moved into the area from Canada at various times throughout the month. The warmth in the Northern Rockies and Far West was related to generally above normal heights and easterly anomalous flow from the relatively warm continent suppressing the Pacific coastal breezes. Several cities reported their coolest or warmest September of record (table 1). Some of these had also just reported record heat or cold in August (tables 1 and 2 of [2]).

Lynchburg, Va., and Columbus, Ga., observed their fifth consecutive month in September with below normal

TABLE 1.—*Record monthly mean temperatures for September established in 1967*

Station	Mean temperature (° F.)	Departure from normal (° F.)
Jackson, Miss.	69.8	−6.7
Montgomery, Ala.	70.6	−6.5
Birgmingham, Ala.	68.4	−7.9
Pensacola, Fla.	73.2	−5.0
Macon, Ga.	68.7	−7.7
Columbia, S.C.	67.3	−8.0
Charleston, S.C. (City)	*72.9	−4.9
Charlotte, N.C.	**67.0	−5.9
Lynchburg, Va.	63.1	−5.6
Norfolk, Va.	66.5	−6.1
Bristol, Tenn.	62.6	−6.5
Youngstown, Ohio	58.1	−4.4
Brownsville, Tex.	77.7	−3.5
Long Beach, Calif.	75.2	+4.2
Stockton, Calif.	75.7	+3.0
Pendleton, Oreg.	69.9	+5.7
Seattle, Wash.	66.4	+5.2

*Since 1871.
**Tied record set in 1918.

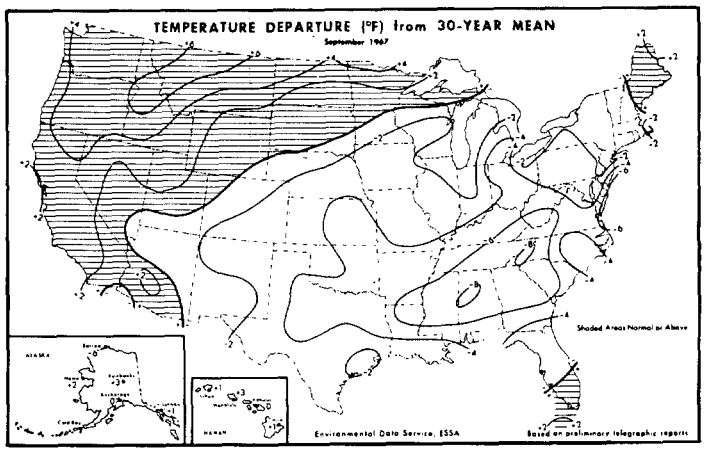


FIGURE 5.—Departure from normal (° F.) of average surface temperature for September 1967 (from [5]).

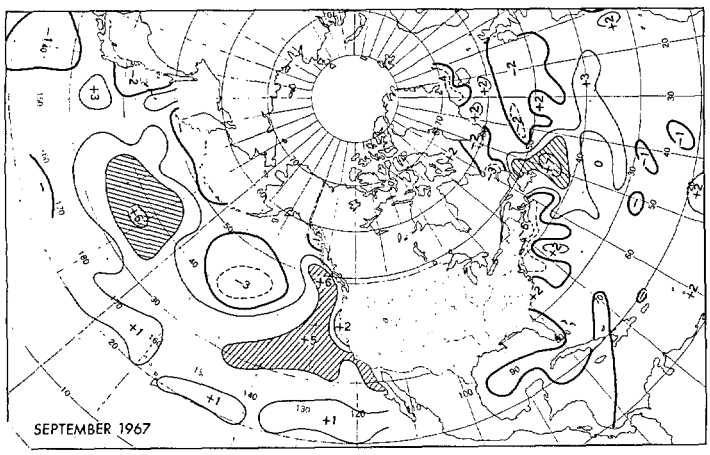


FIGURE 4.—Sea surface temperature departure from normal (° F.) for September 1967. Areas more than 4° F. above normal are shaded.

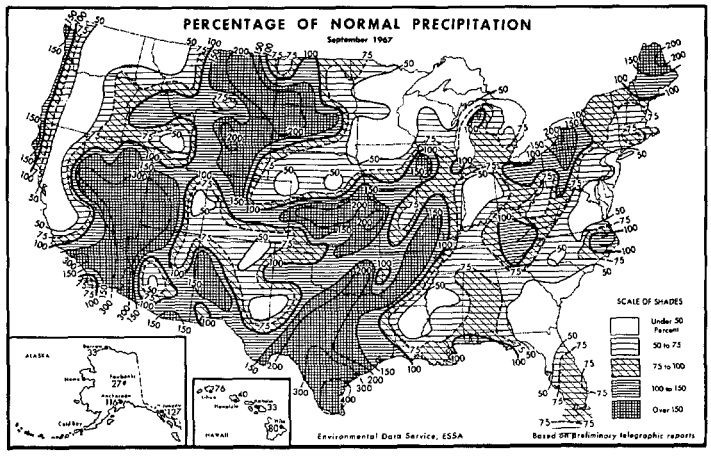


FIGURE 6.—Percentage of normal precipitation for September 1967 (from [5]).

temperature. At Jackson, Miss., May through September 1967 was the coldest such period of record. Macon, Ga., and Birmingham, Ala., both reported this September was the 3d consecutive month of record-breaking coolness. At Macon not a single day from June 1 through September 20 had above normal temperatures, and only 3 days of this 112-day period had normal means. The daily temperatures failed to rise above normal during the entire month of September 1967 at Meridian, Miss.

In contrast, the 10 days with 90° F. or higher at Pendleton, Oreg., during September brought the seasonal total to 76, equalling the record for the period since 1896. Medford, Oreg., reported a record 17 September days above 90° F. and the 3 days with maxima over 90° F. at Portland, Oreg., brought the seasonal total to three greater than ever before in the past 90 yr. Daily maxima were 89° F. or higher every day from June 14 to September 7 at Red Bluff, Calif., and temperatures soared to 100° F. or higher on 46 days. A record 78 consecutive days with temperatures rising to 80° F. or higher terminated September 18 at Los Angeles.

TABLE 2.—*Record daily minimum temperatures established during September 1967*

Station	Temperature (° F.)	Date
Rochester, Minn	23	29
Madison, Wis	33	10
Lansing, Mich	32	23
Sault Ste. Marie, Mich	[1] 30	10
	32	11
Peoria, Ill	44	1
Louisville, Ky	[1] 51	1
Fort Wayne, Ind	[1] 32	23
Cincinnati, Ohio	46	28
Youngstown, Ohio	40	1
	42	2
	[1] 34	11
	38	12
Cleveland, Ohio	35	25
Elkins, W. Va	39	2
Erie, Pa	[1] 45	1
	42	11
	38	25
Buffalo, N.Y	44	1
	39	11
Syracuse, N.Y	42	1
	40	2
Albany, N.Y	41	1
Newark, N.J	51	3
Concord, N.H	38	1
Hartford, Conn	46	1
	43	2
	40	3
Providence, R.I	45	3
Nantucket, Mass	48	3
Norfolk, Va	54	3
	54	4
	49	23
	45	24
Richmond, Va	48	3
	50	4
	43	12
	40	26
Raleigh, N.C	53	4
Charlotte, N.C	53	2
	[1] 52	3
	54	5
	44	24
*Greer, S.C	[2] 36	30
Columbia, S.C	53	2
	48	3
	55	4
	53	5
	51	13
	47	15
	51	16
	44	24
	[2] 40	30
Charleston, S.C. (Airport)	44	24
	42	30
Savannah, Ga	56	15
	55	16
	47	24
	[2] 43	30
Columbus, Ga	[2] 42	29
	[2] 38	30
Athens, Ga	[2] 36	30
Rome, Ga	53	5
	43	23
	32	30
Montgomery, Ala	[2] 39	30
Birmingham, Ala	[2] 37	30
Jackson, Miss	[2] 35	29
Meridian, Miss	[2] 34	29
Chattanooga, Tenn	[2] 36	30
Apalachicola, Fla	[2] 50	29
Tallahassee, Fla	[2] 40	30
New Orleans, La. (Airport)	[2] 45	29
	[2] 42	30
Baton Rouge, La	[2] 47	28
	[2] 43	29
Alexandria, La	[2] 38	29
Port Arthur, Tex	[2] 45	29
Corpus Christi, Tex	54	29
Tulsa, Okla	48	1
Albuquerque, N. Mex	46	14
Milford, Utah	33	14

*Stated that daily low temperature records were broken on 10 days in the month but did not specify when.
[1] Also lowest temperature ever recorded so early in the season.
[2] Also lowest temperature ever observed in September and lowest so early in the season.

TABLE 3.—*Record daily maximum temperatures established during September 1967.*

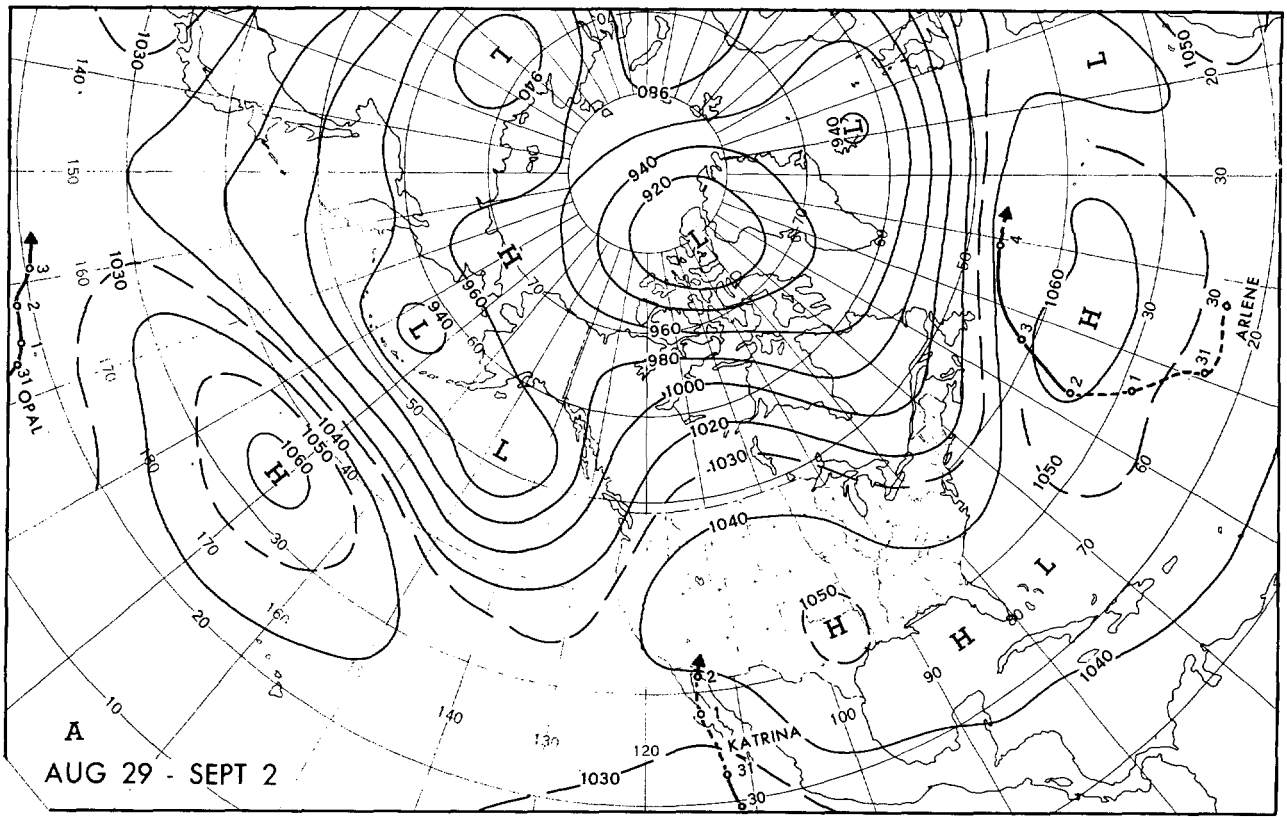
Station	Temperature (° F.)	Date
Huron, S.D	93	25
Billings, Mont	90	28
Missoula, Mont	[1] 99	1
	[2] 95	4
	[2] 96	5
	[2] 92	21
	[2] 88	28
Havre, Mont	[1] 101	5
Helena, Mont	96	1
	[1] 99	5
	90	21
	85	24
	84	29
*Kalispell, Mont	—	—
Casper, Wyo	[2] 86	28
Lander, Wyo	83	29
Salt Lake City, Utah	96	5
Spokane, Wash	90	28
Walla Walla, Wash	94	21
Olympia, Wash	[2] 93	27
Annette, Alaska	[1] 75	15

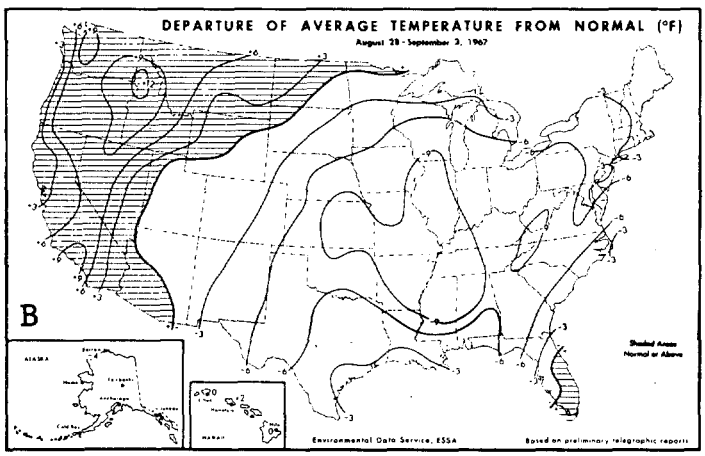
*Stated that daily and late season high temperature records were set on several days but did not specify when.
[1] Also highest temperature ever observed in September and highest so late in the season.
[2] Also highest temperature ever recorded so late in the season.

4. PRECIPITATION

As is generally the case, especially during the warm season, the percentage of normal precipitation is rather poorly correlated with the circulation and its anomalies. However, some features are of interest and lend themselves to plausible explanation. The overall dryness of the Northwest and Northern Mississippi Valley was related to ridge components and positive height anomalies with anticyclonic anomalous flow (fig. 6). Green Bay, Wis., reported its driest September in 80 yr., and Marquette, Mich., tied a dryness record set in 1902. The 19 consecutive rainless days at Lansing, Mich., established a new September record there.

Although the monthly mean height was above normal over the Western Plains and Northern Rockies, the cyclonic curvature in the height anomaly isopleths reflects an intense cut-off Low which developed in the area around mid-month, leading to heavy precipitation.





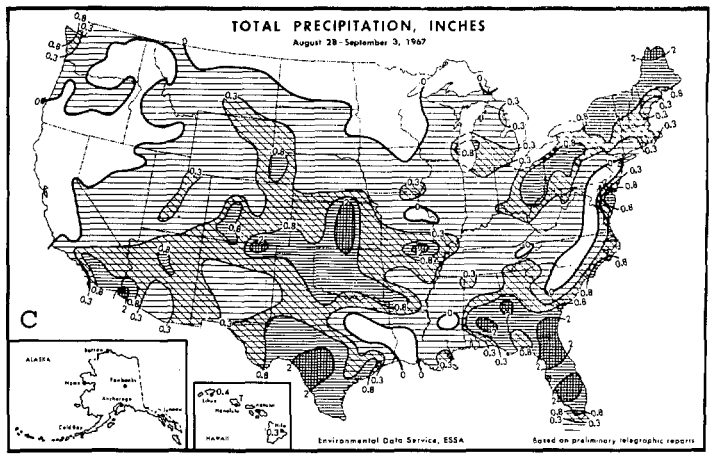
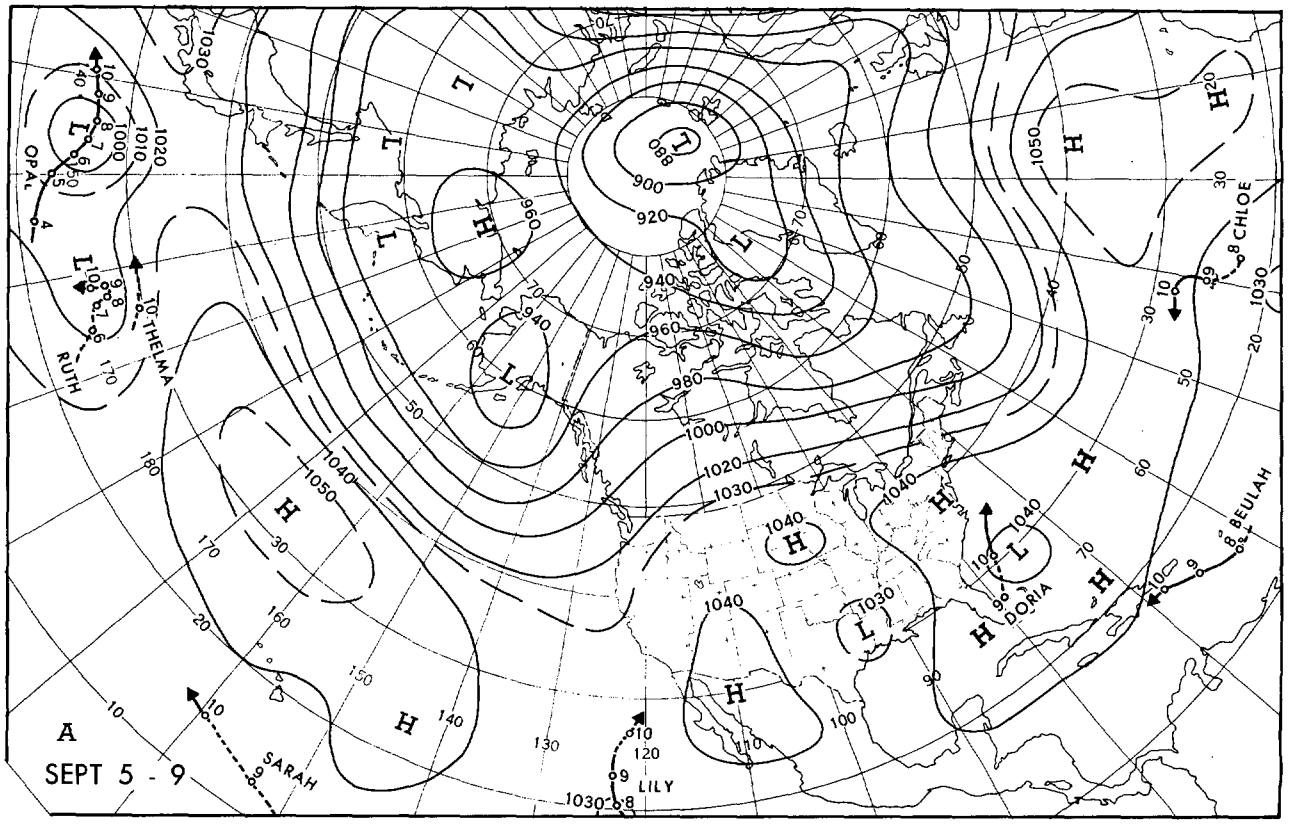
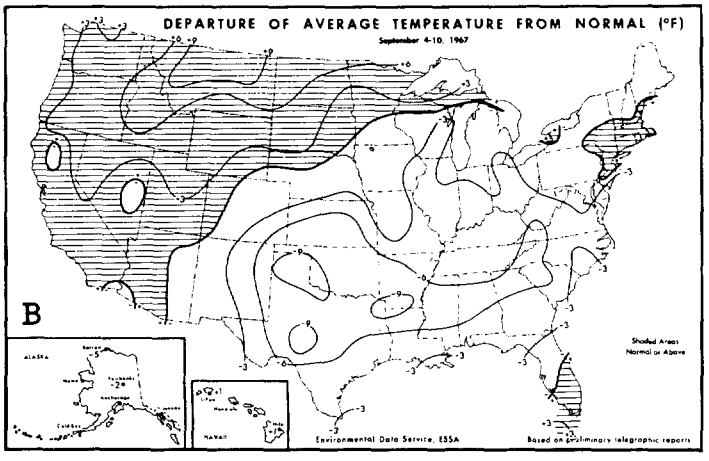


FIGURE 7.—(A) Mean 700-mb. contours (tens of feet) for August 29–September 2, 1967; (B) departure of average surface temperature from normal (°F.); and (C) total precipitation (in.) for week of August 28–September 3, 1967 (from [5]). Preliminary tracks of tropical cyclones are shown in (A) with 1200 GMT positions indicated by dated circles. A solid path line indicates hurricane or typhoon intensity; all lesser intensities, including tropical depression and extratropical phases, are shown by dashed lines.

Heavy precipitation over southern Texas (over 400 percent of normal) shows the influence of Beulah, and the abnormal wetness of southern California was due to a tropical storm which entered the northern Gulf of California, and a weak but persistent cut-off Low in the Southwest which helped advect tropical moisture into the deserts and the Basin. September was the first month to be wetter than normal since January 1966 at Yuma, Ariz., and it was the wettest September of record at Ely, Nev.

Relative dryness over much of the Southeast is difficult to explain in view of the below normal heights in the area. However, surface flow had an anomalous continental com-





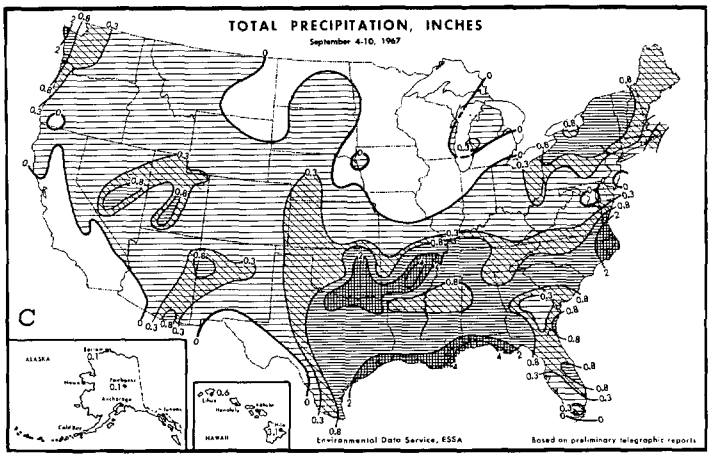


FIGURE 8.—Same as figure 7, (A) for September 5–9, 1967; (B) and (C) for week of September 4–10, 1967 (from [5]).

ponent from the north and the extreme surface coolness may have contributed to greater than normal atmospheric stability.

The airport stations at McGrath and Nome, Alaska, reported their driest Septembers of record. This was probably due to the anomalous easterly component of flow both at 700 mb. (fig. 2) and at the surface (not shown) keeping out Pacific moisture, and the fact that most of the storms moved south of their usual September paths into the deep Gulf of Alaska Low.

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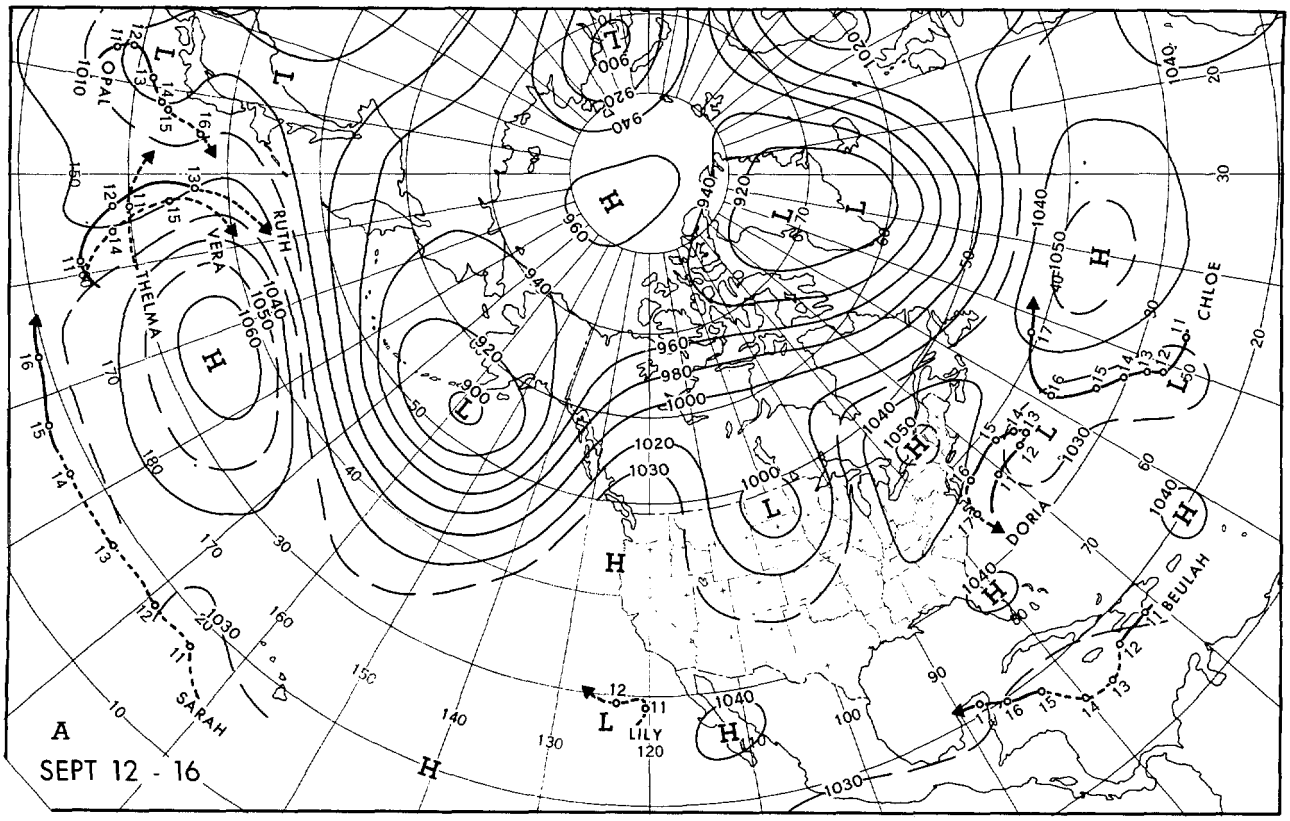
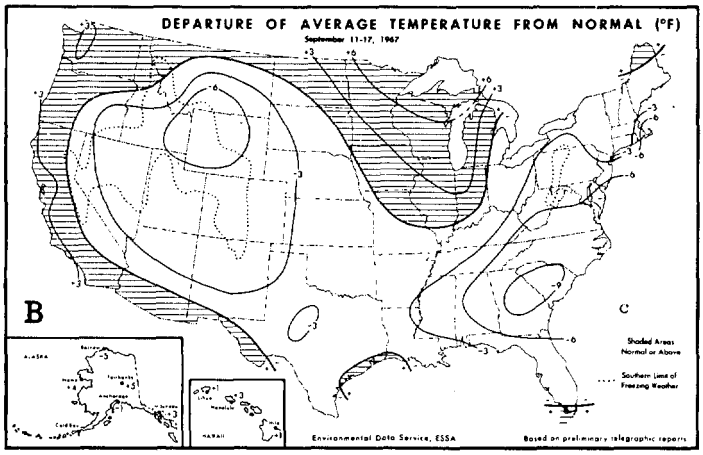




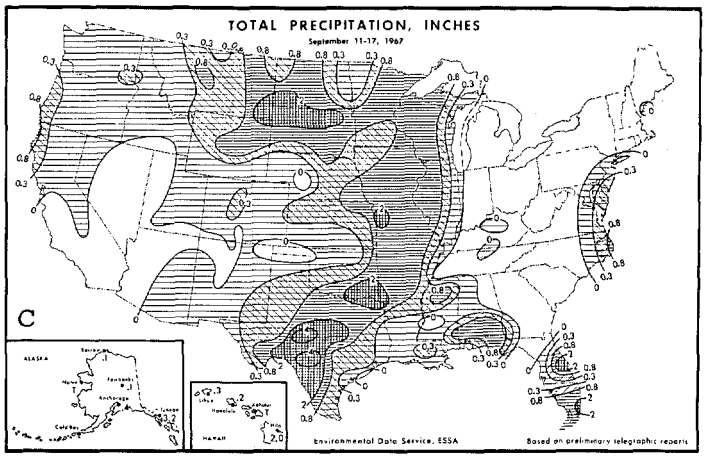
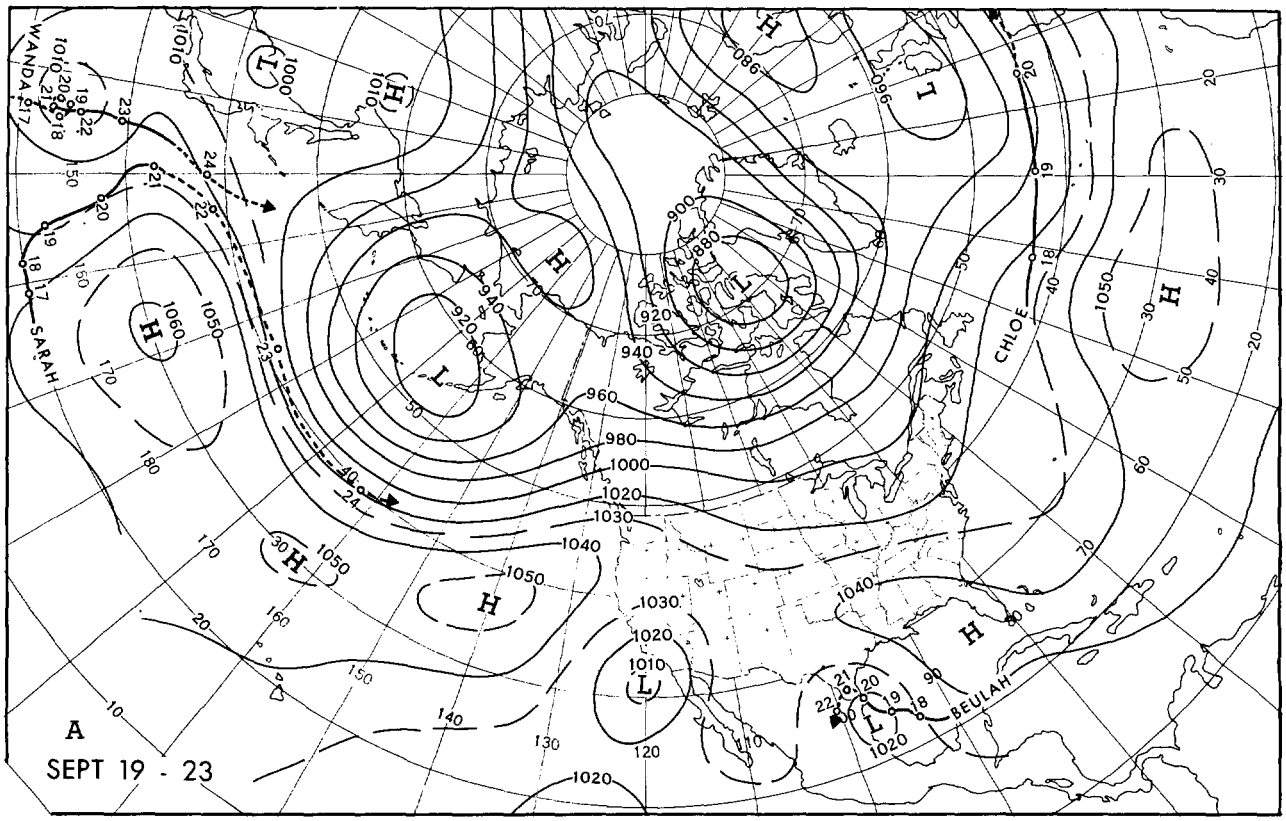


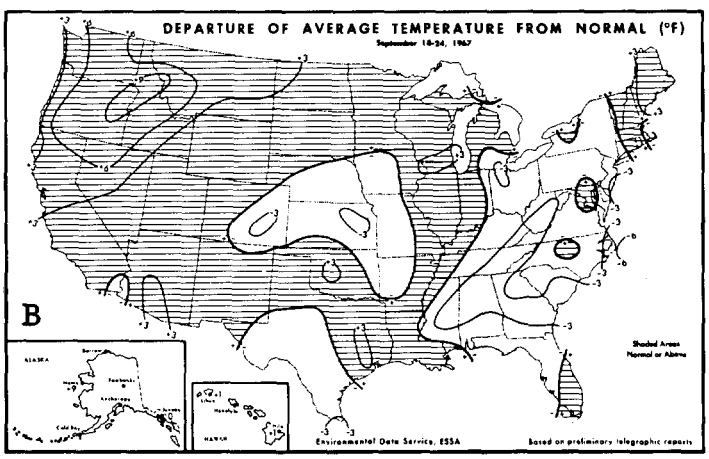
FIGURE 9.—Same as figure 7, (A) for September 12–16; (B) and (C) for week of September 11–17, 1967 (from [5]).

5. WEEKLY CIRCULATION AND WEATHER

AUGUST 28–SEPTEMBER 3

As the month opened, a strong full-latitude ridge was observed over the Western Plains and Canadian Prairies (fig. 7A), with 700-mb. heights more than 300 ft. above normal over Saskatchewan and Manitoba. Record high temperatures were set on the first day of the month in Montana (table 3), and a reading of 100° F. at Medicine Hat marked the first time that temperature had ever been observed in Alberta during September. Weekly temperatures were as much as 12° F. above normal in Idaho (fig. 7B).





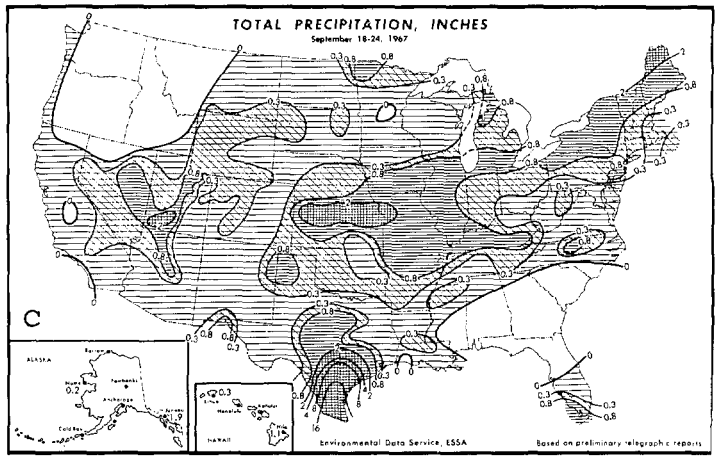
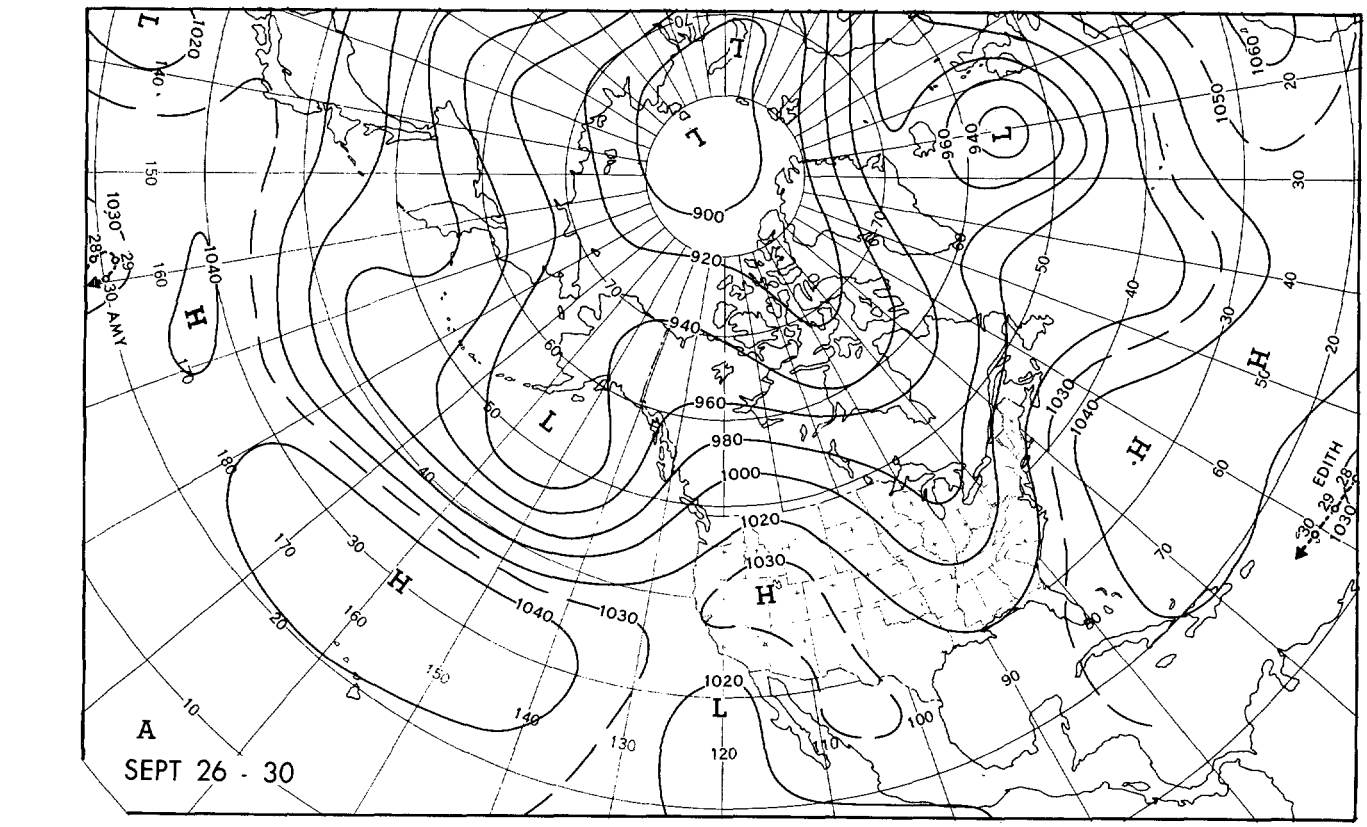
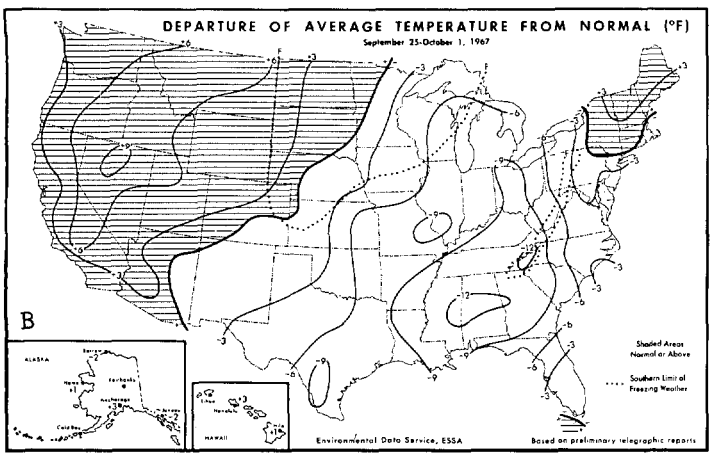


FIGURE 10.—Same as figure 7, (A) for September 19–23; (B) and (C) for week of September 18–24, 1967 (from [5]).

The strong western ridge also served to drive unusually cool air from eastern and central Canada into the eastern United States. Numerous cities reported record-breaking low temperatures on the first few days of the month (table 2), and weekly temperatures averaged more than 9° F. below normal over a large part of the central Mississippi Valley (fig. 7B).

Although very little rain fell in the drought-parched Northwest, where extensive forest fires were still raging out of control, precipitation was heavy over parts of the





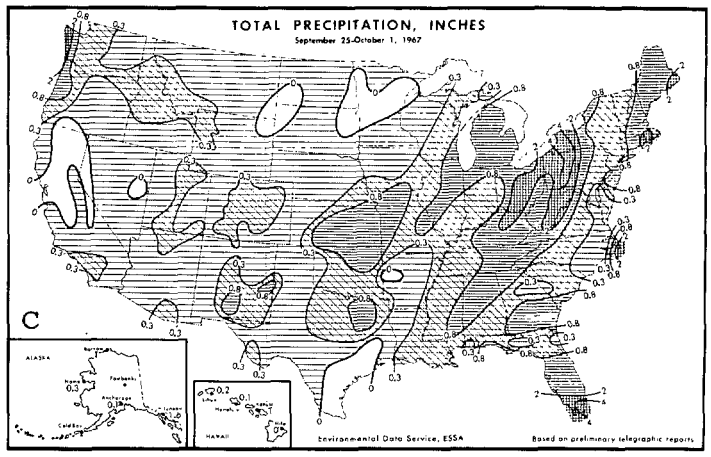


FIGURE 11.—Same as figure 7, (A) for September 26–30; (B) and (C) for week of September 25–October 1, 1967 (from [5]).

Southeast, northern New England, the Central and Southern Plains, and the far Southwest (fig. 7C). Tropical storm Katrina, which moved across Baja California into southwestern Arizona, brought the heaviest rains in 4 yr. to Yuma, Ariz. (fig. 7A). The 1.88 in. which fell there within a 24-hr. period on the 1st and 2d days of the month was more than the normal total for the whole fall season.

Tropical storm Arlene, which formed the last few days of August and was the first Atlantic storm of the season,

circled around the western edge of a strong Bermuda-Azores High to join the westerlies, after briefly gaining hurricane status. Typhoon Opal was moving toward the southwest Pacific south of a similarly strong central Pacific High (fig. 7A).

SEPTEMBER 4–10

Above normal heights spread across southern Canada and the northern United States as the trough in the east moved out over the western Atlantic (fig. 8A). The overall temperature pattern did not show much change from the previous week, except that the coolest weather relative to normal was in the Southern Plains and the core of the warmth crossed the northern Rockies into Montana (fig. 8B).

Heavy precipitation occurred in connection with a slowly moving Low which was secluded in the Southern Plains for several days by the strong ridge to its north (figs. 8A, C). The first substantial rains of fall moved into the Pacific Northwest, breaking some of the longest rainless periods on record in that area.

Tropical activity was on the increase in both the Atlantic and Pacific. Hurricane Doria developed from an initially cold cut-off Low left off the Southeast coast when the eastern trough present the previous week sheared (fig. 8A). Heavy rains and moderately strong winds were observed in the Cape Hatteras area as Doria moved northeastward (fig. 8C). Farther out in the Atlantic, Beulah and Chloe had formed from easterly waves a few days earlier.

In the eastern Pacific, Hurricane Lily was moving northward toward southern California before weakening to tropical storm intensity. Tropical storm Sarah formed southeast of Hawaii in an area where few tropical developments are known to occur, and began moving westward while attaining hurricane status.

In the western Pacific, typhoon Opal had become a huge, though not particularly intense, slowly moving storm, impressing itself on both the 5-day and 30-day mean circulation patterns (figs. 1 and 8A). Two new tropical storms developed to the east of Opal.

SEPTEMBER 11–17

During the middle week of September the 700-mb. circulation attained an extremely unusual configuration over much of the western half of the Northern Hemisphere, and tropical storm activity reached a climax in both oceans (fig. 9A). The principal positive height anomaly in the southern Canadian area shifted to Quebec, where 5-day mean heights were 510 ft. above normal (not shown). The trough which helped to break the Northwest drought the previous week formed a cut-off Low over the Northern Plains on the 5-day mean circulation pattern. As a result of these developments, the first extensive cool air mass in several weeks was brought into the Basin and Rockies, rapid warming occurred in the western Great Lakes area, and heavy rains broke out in the Dakotas (figs. 9B, C). A new record of 8.85 in. of rain within a 24-hr. period was set at the airport station in Dubuque, Iowa, on the 14th.

Over the eastern Lakes, the Northeast, and neighboring parts of Canada the number of consecutive rainless days set new September records at several localities. Detroit and Lansing, Mich., had 19 consecutive rainless days; Hartford, Conn., measured rain on only one of the first 18 days of September, and parts of southern Ontario had no rain the first 20 days of the month.

In the Atlantic, Chloe and Doria moved toward each other and then separated (fig. 9A). Although Chloe followed a fairly conventional path, the net effect of the Fujiwhara interaction between the two hurricanes, and the strong ridge which built over the Northeast in response to the cut-off Low over the Dakotas, was to at first retard the northward progress of Doria and then send her back westward toward the Middle Atlantic Coast. This was the first time of record that a hurricane has made landfall north of Cape Hatteras moving on a track from the east and northeast.

It is in fact most unusual that a hurricane should retain its intensity for so long north of 35° N. in the western Atlantic. The fact that the High over the Northeast was warm (except for surface coolness due to radiation and cold water in the Bay of Fundy) and that the ocean surface temperature was abnormally warm southeast of Newfoundland may have contributed to keeping these storms alive (fig. 4). Doria did begin to lose strength even before landfall when she moved near and over the cooler (both absolutely and relative to normal) water near the coast. The highest winds officially reported from a major weather station were a fastest mile of 40 m.p.h. and a peak gust of 55 m.p.h. from the northeast at Norfolk, Va. Rainfall from Doria was not particularly heavy (fig. 9C).

After striking southern Haiti and temporarily losing strength, Beulah headed on a meandering path toward the western Caribbean, where she again regained hurricane intensity.

In the eastern Pacific, tropical storm Lily dissipated after turning westward. Sarah, which had been briefly a hurricane south of Hawaii, again deepened to become a typhoon on the 15th of the month west of the International Date Line. A day later, Sarah passed over Wake Island with devastating force. The central pressure in the eye was measured at 933 mb. and the anemometer recorded a gust of 116 kt. before failing.

Four tropical storms, two of typhoon intensity, were underway in the western Pacific. Most of these and subsequent storms eventually were caught in the westerlies and probably contributed to strong baroclinic deepening of systems which moved into and contributed to the record deep Low in the Gulf of Alaska. During the period September 12–16, the Aleutian Low reached its greatest intensity, with 700-mb. heights 860 ft. below normal. Three surface systems deepened below 970 mb. during

September in the area as the unusually warm water in the west central Pacific contributed to increased surface baroclinicity and provided additional latent heat (fig. 4). Namias discusses a similar situation which occurred further east during the fall of 1962 [4].

SEPTEMBER 18–24

A strong ridge began to build over the Pacific Northwest and British Columbia during the 3d full week in September, again sending temperatures far above normal in the area (figs. 10A, B). A closed Low secluded off southern California helped to pump moisture into the Basin, with over 2 in. of rain being observed in southwestern Utah (fig. 10C).

The weather highlight of the week was hurricane Beulah, which attained the status of the second deepest Gulf hurricane of record (27.26-in. surface pressure by dropsonde) shortly before devastating the southern Texas coast and lower Rio Grande Valley with fierce winds and torrential rains. An extensive area of southern Texas experienced storm totals of over 16 in., with some unofficial readings of up to 30 in. of rain. Additional damage was done by 95 tornadoes spawned by Beulah. Total damage, mostly from flooding, was expected to approach one billion dollars.

A ridge component over the Southeast kept that area rainless (figs. 10A, C), while frontal precipitation spread eastward to New England from the Central Plains.

Doria failed to regain tropical storm intensity, even though a weak circulation center could be traced off the Southeast coast for several days. Perhaps the mean westerly winds in the region were unfavorable for redevelopment even though water temperatures were near or slightly above normal in the general area (figs. 4 and 10A).

Chloe, however, did retain hurricane intensity and was considered to remain tropical as far east as 15° W. at about 43° N. An area of quite warm water west of Portugal may have helped to maintain Chloe's intensity longer than what normally is the case for tropical storms in this area.

Typhoon Sarah curved northward and then rapidly eastward before joining with a polar storm on the 24th to redeepen the Aleutian Low. Another tropical storm, Wanda, which attained typhoon intensity for a few days, moved northward southeast of Japan after making a slow, closed loop (fig. 10A). Two other tropical storms, Monica and Nanette, developed in the eastern Pacific south of the area covered by the map.

SEPTEMBER 25–OCTOBER 1

The circulation pattern over North America amplified during the final week of September (fig. 11A) as the Rockies ridge was reestablished and a deep trough developed southward through the Great Lakes and Ohio Valley. This led to numerous additional records of daily and early season cold in the Midwest and South (table 2) and corresponding record warmth in the Northwest (table 3). Weekly mean temperatures were as much as 9° F. above normal in Nevada and 12° F. below normal in the South (fig. 11B).

An early-season Appalachian storm more typical of November than September moved northward to the eastern Lakes, producing a new September 24-hr. record rainfall of 3.63 in. at Buffalo and setting off flash floods on small streams in western Pennsylvania and New York (fig. 11C). Some areas had up to 6 in. from the storm. Although the surface circulation did not reach great intensity, the deep upper Low and cold air aloft produced graupel at Green Bay, Wis., and traces of snow at Mansfield, Ohio, and Beckley, W. Va. on the 29th. This marked the first time these phenomena had ever been observed at these localities during September.

Only two weak tropical storms were active during the last week of September. Edith was barely more than an easterly wave as she moved through the Antilles, and Amy marked the start of a new run through the alphabet in the western Pacific.

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CORRECTION NOTICES, VOLUME 95

No. 1, Jan. 1967, p. 51: Substitute the corrected map reprinted in vol. 95, No. 4, Apr. 1967, p. 234.

No. 4, Apr. 1967: p. 218: The last sentence on the page should read ". . . condensation levels were *lower* over the Bahama Islands . . ." instead of "higher."

No. 7, July 1967: front cover, Contents, pp. 463–467, authors' names should be M. Wolk, F. Van Cleef, and G. Yamamoto. Also pp. 480–481, author's name should be Frances C. Parmenter.

No. 8, Aug. 1967: p. 540, left column, entry 5, *Journal of Meteorology* should read *Journal of Applied Meteorology*.

No. 9, Sept. 1967: p. 607, right column, third paragraph, first sentence should read "The basic wind data were taken from U.S. Navy Oceanographic Office Pilot Chart wind roses." Also fourth paragraph, first sentence should read ". . . U.S. Navy *Marine Climatic Atlas of the World*, . . ."